Next Generation Instrumentation Bus

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NexGenBus

Requirement

Current programs such as F/A-18 E/F, F-22, and JSF all have composite data rate requirements that exceed the capacity of any single instrumentation system bus. These programs have accommodated their data requirements with a clumsy arrangement of multiplexers. The increased fusion of data from numerous sources (i.e. analog measurements, digital buses, digital radar data, and digitized video) to support testing and simulation will simply overwhelm this approach. The instrumentation community needs a single standard instrumentation bus with data rates significantly greater than the current standard. To comply with Acquisition Reform and the emphasis on COTS hardware, the instrumentation community needs to adopt a high speed bus standard. This would provide the instrumentation vendors a clear commercial interface standard that can be used to modify/develop COTS hardware.

Program

NexGenBus is an OSD sponsored program with tri-service participation that is leading the way to network based test instrumentation systems. The goal is to establish a commercial communications bus as a standard for the test instrumentation system of the future.

Payoff

This will enable the instrumentation community to leverage off developments and purchasing power in other industrial areas – like the consumer PC market. Many benefits can be derived from sharing a common bus. The most obvious is a lower cost of ownership for the bus itself (interface hardware, support equipment, and software). Additional benefits include the portability of the data and peripherals (hard drives, displays, etc) that may be adapted for use in a test article.

Strategy

This project will be executed in 4 phases across 3 years.

Phase one of this project will be the detailed definition of the requirements for the next generation instrumentation bus. This will begin with a comprehensive analysis of the overall data acquisition network requirements. Once the overall data acquisition network requirements are defined, the required capabilities of the instrumentation bus can be developed.

Phase two will be a technical review of the existing bus standards to determine if any meet the bus requirements developed in phase one. This analysis shall include:

1) Compatibility of data protocols with the requirements.
2) Compatibility of the physical layer with the environment (EMI, vibration, temperature, etc.)
3) Verification that the standard has sufficient detail to ensure compatibility

Phase three will verify the bus or busses selected in phase 2 can perform in the test instrumentation environment. This phase will consist of laboratory tests, analyses, and simulations.

> *If the outcome of phase two or three reveals that no existing standard will meet the requirements, this project will be terminated.*

Phase four will provide the engineering support to write the physical standard based on the selected bus

Check the NGB Web Page For Current Information

http://NexGenBus.Nawcad.Navy.Mil

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NexGenBus Project Execution

Data System Definition With the goal of defining the evaluation criteria for instrumentation busses, the system features of a 'Future Data Acquisition System' were identified. One of the major requirements was the ability to bridge to units on other busses thus allowing existing instrumentation inventories to be used. Other features included simultaneous sampling, various data inputs and outputs, smart transducers, environmental, and network topology.

Bus Requirements The data system definition was used as a framework. For each data system element, the associated bus characteristic was determined. As insights and information were gained, the list was updated.

Compile Bus List The world was searched for non-proprietary communications busses. Leading the charge were generic open searches on the web using several of the more prominent search engines. This was closely followed by thorough searches of standards organizations (IEEE, ANSI, etc.). Trade journals and technical magazines provided a lot of timely information on trends and busses being used in the industry. The search turned up more than 33 busses. Twenty five of which were serial.

Potential Busses The minimum requirement for bus speed was considered to be an order of magnitude greater than the current standard. Eight serial busses with rates greater than 100 Mbps were identified (see table). These busses were selected for further review. The purpose of this stage was to quickly eliminate those busses that could not reasonably be used in an instrumentation environment. The standards were considered as written. Deviations in practice were not considered. Using the OSI reference model, these busses were graded at the lower layers. Physical and data link criterion such as bus rate, BER, and media were used. Some other more intangible measures were used as well (e.g. Field manufacturability of cables/connectors, cable bend radius, and industry acceptance).

Viable Busses The resultant three busses – Fibre Channel, Firewire, and Gigabit Ethernet – were studied in more detail. During the potential bus phase, there was more emphasis placed on the lower OSI layers. This phase focused on whether the upper layers could perform critical instrumentation related tasks. Some of the more prominent issues were determinism, latency, and synchronicity. The busses were judged on market as well as performance factors.

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Each bus was rated high, medium, or low on 13 items. The ratings were converted to numerical scores with the average scores (out of 10) shown in the table below. Fibre Channel was the hands down winner. This supports what is being seen in the field. Of the three busses, ***Fibre Channel is the only one being used in a military flight environment.***

Bus	Avg Score
Fibre Channel	**8.85**
Gigabit Ethernet	5.00
Firewire	4.46

Define Test/Simulation Requirements (Ongoing)
The outputs of the previous tasks are being used to help define our test program. The goal of the test program is to identify weaknesses in areas critical to instrumentation. Whenever possible, ways to work within the standard to avoid these weaknesses will be noted.

The test program will be accomplished in a number of ways. The most obvious way is to actually test a device in the lab. However, because we will be testing COTS end-items, we may not be able to isolate just the area under test. As a result, we may test a function over several layers and try to interpolate the results. Other methods of test available to us include analysis, inspection, and adoption of test results performed elsewhere.

There are multiple protocols that can be run on top of Fibre Channel. Choosing the best one will be difficult at best. Part of the test program includes simulating a data acquisition network using various protocols on top of Fibre Channel in order to select the best one(s).

The test and simulation plans are currently under development.

Schedule	Complete	
Phase I Define Requirements		
• Data System Definition	10/97	✓
• Bus Requirements	1/98	✓
Phase II Research		
• Compile Bus List	1/98	✓
• Potential Busses	4/98	✓
• Viable Busses	10/98	✓
Phase III Test		
• Define Test/Sim Requirements	1/98	
• Perform Tests/Simulations	10/99	
Phase IV Standard		
• Write Final Standard	9/00	